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THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTION OF BRITISH FOUNDRYMEN AND THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION

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Forthcoming Events.

Institution of British Foundrymen.

Lancashire Branch.—Annual dinner; "The Solution Theory of Alloys, with special reference to Cast Iron," by F. J. Brisler, on January 14.

Sheffield Branch.—"Semi-Steel," by J. Cameron, on January 20.

Glasgow Section.—"The Cupola," by D. McQueen, on January 21.

Falkirk Section.—Lecture, with experiments, by A. Campion, on January 21.

East Midland Branch.—"Foundry Facings," by H. Winterton, on January 28, 1922, at Loughborough.

Staffordshire Iron and Steel Institute.

"Electric Welding," by W. H. Walton, on January 21.

West of Scotland Iron and Steel Institute.

"Centrifugal Castings," by J. E. Hurst, on January 20.

British and Foreign Synthetic Iron.

Processes Compared

The experiments which have been made at Rombachhütte, described on page 29 of this issue, though of rather a unique character were not the only methods employed during the war for the conversion of steel into pig-iron. In Italy and France, a special yet simple form of electric furnace was used for this purpose. Briefly, this latter process consisted in the continuous charging of suitable mixtures of steel turnings, lime, carbon (coke or other material), and ferro-silicon into an open-topped, carbon-lined cylindrical furnace, the energy being supplied by either one or three electrodes suspended from the shop roof or a bridge. This process has much to commend itself under the conditions of cheap electric power, unlimited steel turnings and a shortage of pig-iron, but all these special conditions never existed in Great Britain during the war, but an allied problem made experiments worth while. This allied problem was the shortage of Swedish white pig-iron, which is one of the bases of Sheffield tool steel manufacture. For making a synthetic iron in this case a most rigid specification had to be met. The sulphur and phosphorus had to be kept below 0.02 per cent. Such specification is comparatively easy to meet when making electric steel, ordinary or special, from a pure base, but for the manufacture of synthetic pig, the process superficially invites the use of less pure material on account of cost.

The manufacture of synthetic white pig-iron of Swedish quality was investigated by Mr. Victor Stobie, of Dunston-on-Tyne. Realising that the intense reduction of the sulphurs associated with the building up of the carbon content meant the establishment of powerful reducing conditions, Mr. Stobie doubted whether the most expert slagging-off of the slag from a phosphorus free bath could be accomplished sufficiently well to prevent the phosphorus from passing the 0.02 mark on the introduction of reducing conditions. He, therefore, constructed two 20-ton stationary electric furnaces at two levels. The primary furnace, on the higher level, was the one in which melting and the refining based on oxidising reactions was conducted. When the metal had been refined to the usual "slagging-off period" composition of C. 0.07, Si 0.02, P. 0.009 and S. 0.03 to 0.06 per cent., a tap-hole was opened and the metal allowed to run into the secondary furnace, the slag on its appearance being diverted by a Y-shaped runner. In the secondary furnace the metal met an excess of pure carbon and lime, which set up intensely reducing conditions seldom met with in workshop metallurgy. No difficulty was experienced in reducing the sulphur to well within the limit, but though the phosphorus specification of 0.02 per cent. was usually met there was the same increase in phosphorus noted by the Rombach concern. In both this and Mr. Stobie's process the phosphoric slag will contain between 20 and 35 per cent. of metallic iron, whilst the metal with which it is associated contains an unknown but possibly very high quantity of gas. Obviously in the cold there would be a strong differentiation in the specific gravities of the two, but at steel-making temperatures they appear to be sufficiently near one another as to be at least partially miscible. Whilst it is commercially fortunate that the need for synthetic pig-iron in this country no longer exists, it is a metallurgical catastrophe, for experiments carried out on the lines of Rombachhütte and Stobie are extremely enlightening, and in time would go far to prove or disprove the existence of "inherent properties," "body," and similar metallurgical mysteries.

The Co-operation of the Engineer and Chemist in the Control of Plants and Processes.*

By G. M. Gill, M.I.Mech.E.

A great need exists to-day for the supply of materials which have some pretence of being standardised, with quality, size and general characteristics much more uniform than is frequently the case with most manufactured commodities. With such variations in raw and other materials used for manufacturing purposes, it becomes a difficult problem to work plant and processes efficiently, and in such a way as to produce articles of standard quality and quantity. As a result great loss is caused to the country's trade and industry generally.

It is proposed in this Paper to deal specifically with coal and refractory materials, and to outline a system which has been applied with the object of standardising the quality of gas. The South Metropolitan Gas Company, being a user of coal to the extent of 1¼ million tons per annum, has found it desirable to establish a fully equipped laboratory and inspecting staff at Newcastle-on-Tyne for the purpose of examining coals supplied to the company. The coal is sampled as it is loaded into the Company's ships, after which the samples are analysed, and all coal above a definite size is hand-picked free from dirt, the results being telegraphed to London in time to give those responsible for the operation of the works an opportunity of regulating the carbonising plant to suit the varying grades of coal before its arrival. This system is still in its infancy, but excellent results are anticipated not only from the point of view of better informed buying, but also of improvement in the cleaning of coals and in the working of plant to suit each consignment of coal. One of this Company's stations has already instituted a system of carbonising by which automatic adjustments are made varying with the volatile content in each consignment of coal. It should here be explained that in good carbonising from 90-95 per cent. of the volatile content in the coal is converted into gas and liquid products, and as the percentage of volatile matter in the coals used varies from, say, 24 to 34, it will be realised that the one class of coal needs very different treatment to the other, though it is a factor which has hitherto been neglected in gasworks practice owing to lack of information.

In gas works generally the class of coal in use is varying in some cases from hour to hour, and in others from day to day, and as consignments of coal differ so largely it is not customary to alter the regulation of plant until some time after a fresh class of coal has been in use and its effect has become apparent to those in charge. This change is generally too late for full advantage to be taken of the characteristics of the coal, but if this could be done before a commencement is made on a fresh class of coal much benefit would be derived. At the present time the name of a coal is the only indication of its quality and characteristics, but each coal varies so largely that the name is little indication of its quality.

Coal is everywhere bought not by quality but by name, and its price varies with the general reputation of the name in question, but there is so wide a variation in the quality of each coal that the worst cargoes of a so-called first-class coal are inferior to the best of a second-class coal. There is, in fact, a large element of chance in regard to the quality of any particular consignment.

The author would suggest that the time has arrived when each colliery should grade or classify the coals from the various pits and seams, keeping each grade of the same quality within the narrowest practical limits. The advantages of such a step to the users would be very great, and this would react favourably upon the whole coal industry. To a gas undertaking it would result in higher yields of gas and products per ton of coal and per unit of plant, a higher output per man, and a smaller variation in the quality of gas made, and these would have the effect of reducing the price of gas. The desired improvement would be much nearer achievement if the coal were picked more efficiently and consistently, though, of course, this is not the whole of the problem.

In examining the samples of coals, these are screened through a sieve with holes ½ in. square, and the coarse portion not passing through is hand-packed free from dirt, the quantities of which dirt are shown in the diagrams. A study of these figures makes it quite clear that the picking process at the pits is a haphazard one, varying possibly in efficiency with the dates of the football matches in the district. The presence of this superfluous dirt in the coal causes untold loss in a gasworks. There is not only the fact that the buyer is receiving dirt instead of coal, but the dirt is transferred to the coke which is used in the furnaces for heating the retorts in which the coal is carbonised. In practice the heating of the retorts is very greatly affected by the amount of dirt in the coke, and as a consequence its presence in the original coal is most objectionable.

The author would suggest that, in the working of a colliery, continuous sampling of the coal as it reaches the surface should be the daily and nightly duty of chemists, who would test the coal both physically and chemically, supplying the superintendent in charge with complete records of the quality of the coal, by which system the quality could readily be standardised within limits varying with the consistency of the particular seams. The working of such a system would entail the employment of chemists in the collieries to a much greater extent than is now the case, and this would lead to the production of a better and more uniform quality of coal.

TABLE 1.

Showing the Maximum and Minimum Dimensions found by examining twenty-four (Firebricks of each of two well-known makers) chosen at random from a stack of such bricks. The Correct Dimensions should be 9 × 4.5 × 3 in.

—	Length. Inches.	Breadth. Inches.	Thickness. Inches.
MAKER (A)—			
Maximum	9.30	4.56	3.16
Minimum	9.01	4.40	2.90
Difference	0.29	0.16	0.26
MAKER (B)—			
Maximum	9.35	4.5	3.12
Minimum	8.92	4.27	2.87
Difference	0.43	0.23	0.25

The effect of such improvement would undoubtedly be far-reaching, and while the author holds no brief for chemists, he is strongly of opinion that their presence at the engineer's side is essential to the proper conduct of industries generally, and here in the working of collieries is clearly fine scope for mutual co-operation between the members of the two professions.

Refractories.

The variation in size and quality of fire-bricks and blocks and retorts is one of the most unsatisfactory features with which users of refractories have to contend. All kinds of difficult problems have to be faced for want of uniformity in this respect. Table I. shows the varying length, width, and thickness of fire-bricks supplied by two well-known makers in this country.

Three pieces of retort which were picked out from seven pieces chosen at random from a quantity in stock supplied by a well-known manufacturer. These three pieces have been placed together to make up the usual length of a 20-ft. retort. The internal dimensions of these pieces should have been 22 in. by 15½ in. of an oval section. Actually the dimensions in the 20-ft. length vary from 22.50 in. to 21.68 in. wide, and from 15.50 in. to 15.31 in. in height. As used in a gas-

* Extracted from a paper read before a joint meeting of The Institution of Mechanical Engineers with the Society of Chemica Industry on January 6, 1922.

works, these retorts are charged with coal. The charge of coke has then to be pushed out at one side, and in some cases the direction in which it is pushed is varied from day to day. It is obvious that where one part of the retort is larger than another part the charge in the larger part can only with difficulty be pushed through the smaller part of the retort, and this fact undoubtedly causes practical difficulties in working.

The dimensions of the retorts should be, within practical limits, the same from end to end, both internally and externally. The internal dimensions affect the discharging operations and the external dimensions affect the building of the settings, a large amount of cutting of bricks and blocks being necessary where the retort is of a bad shape. Unfortunately, where the shape of the material is bad, human nature being what it is, the workmanship is also frequently bad, the difficulties of the retort setter being so much increased by the faulty shape of the retorts.

Such variations are typical of material supplied by most of the fire-brick makers in this country, and the author has no hesitation in asserting that it is high time that fire-brick makers started to employ rational methods in the control of the ingredients used in brick-making, and of their mixing, drying, and burning. The variation in size is doubtless due to faults in one or other of these parts of the process, such faults being allowed to develop in the course of manufacture owing to a complete absence, in most fire-brick works, of any semblance of scientific control.

In visiting a fire-brick works, one is usually told that the important work of controlling the kilns is left in the hands of a workman upon whose judgment, without the aid of instruments, depends the degree and uniformity of the temperature and the period over which it is extended. The same is true of the choice and mixing of the raw materials from which the bricks are made. To anyone accustomed to the aid which is given by chemists and others whose duties consist of keeping a regular check upon all the factors which contribute to the maintenance of uniformity in the quality of manufactured commodities, it is, of course, obvious that the absence of this absolutely necessary assistance can but result in the defects of which mention has been made.

In the building of any structure of refractory materials it is highly important that the joints between bricks and blocks should be as thin as possible, the bricks being "buttered" only, and consequently it is all-important that the thickness of such bricks should be uniform, as otherwise the bricklayer must either sort over all the bricks to get those of a similar thickness to lay in one course, or he must increase the thickness of the joint wherever the thin bricks are laid. In either case the remedy is very objectionable. Here, again, there is scope for the chemist to work in conjunction with the engineer or manufacturer.

What appears to the author to be necessary in the conduct of fire-brick works is the institution of methods providing for:—

(1) The continuous sampling and analyses of mixtures in use, both chemical and physical. (2) The use of heat recorders in kilns. (3) Definite limiting standards for size and shape. (4) Guaranteed working to specifications.

It might be argued that the extra cost of applying such methods would not be forthcoming from the sale of the materials made, or, in other words, that the bricks would be too expensive to sell. It is suggested that the contrary result would be experienced.

The control proposed would doubtless result in the production of a higher and more consistent quality of brick; this would increase sales, and consequently lower overhead charges in the works. The control would further diminish rejected bricks, save fuel costs in kilns, increase capacity of plant and effect improvements which would result from increased knowledge of the process. At present the most enlightened refractory users are searching the country for a better quality of materials, which is of far greater importance than that of price, important though that be.

Refractory users are hopeful, though not confident, that they may find what they require in this country. They do not want to go abroad for their materials, and if this course has to be taken it will be because they have been driven to it by the apathy of the British refractory manufacturer.

Correspondence.

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

Some Principles Underlying Foundry Practice.

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—I have read with interest Mr. Field's presidential address in your issue October 27, and should like additional explanation with regard to one or two of the items mentioned.

In the first place I would inform you that the castings I make are mostly machine moulded, and weigh anywhere from 1 lb. to 5 lbs.

It would be interesting to hear what you would consider the correct temperature of the metal when tapped from the cupola receiver, and also the temperature when poured into moulds for the class of work mentioned. Some little time ago I took an analysis of metal from one of the castings, which is as follows:—Graphitic carbon, 2.93; combined carbon, 0.60; silicon, 1.99; sulphur, 0.028; phosphorus, 0.506; and manganese, 1.02 per cent. An analysis from the same mixture to-day is:—Silicon, 2.15; sulphur, 0.11; phosphorus, 0.98.

I should be glad to hear Mr. Field's views as to what he considers would be a suitable analysis of metal for castings similar to those described, which I omitted to say are machined and polished all over.

The mixture used for the casting from which the above analyses were taken is as follows:—Yorkshire, 15; Scotch, 20; hematite, 15; and scrap, 50 per cent.

The average transverse test on a 1-in. square bar supported at 12-in. centres is usually about 23½ cwt. per sq. in., with a deflection of 3-32 in.—Yours, etc., DEMOSTHENES.

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—I have read with interest the letter from "Demosthenes" arising from my presidential address to the Birmingham Branch, Institution of British Foundrymen.

The query regarding temperatures of metal can only be answered with exactitude after the question of mixture and composition has been settled. The two analyses quoted by your correspondent, although supposed to be of the same mixture, seem to be something very different. It is well known that phosphorus varies very little in one brand of pig-iron over long periods, and therefore if the same mixture be used the phosphorus will usually be found very nearly regular from time to time. In the two analyses presented we have 0.506 per cent. and 0.90 per cent. of this element, an extremely wide difference from the same four brands in the same proportions.

Seeing that the castings are small, viz., 1 to 5 lbs., I would suggest that 0.50 per cent. phosphorus is too low, and that a suitable analysis would be:—Silicon, 2.5; sulphur, 0.10; phosphorus, 1.0; and manganese, 1.0 per cent.

This would give a lower combined carbon than that shown, viz., 0.6 per cent., and a more easily machineable metal.

Such a metal would run with greater fluidity than the one with lower phosphorus, due to the increased quantity of eutectic present and the extended range of solidification. It should leave the cupola at 1,400 deg. C. to 1,425 deg. C., which will denote sufficient superheat to allow of being carried a fair distance and cast into thin or light sections. As to the actual temperature of casting, provided your correspondents have a good facing sand, I should advise them to cast as hot as possible, especially as the work has to be machined all over. In any case the temperature drop will probably be nearly 100 deg. C. between the cupola and mould.—Yours, etc.,

H. FIELD.

Messrs. John Harper & Co., Ltd.,
Albion Works,
Willenhall, Staffs.
December 15.

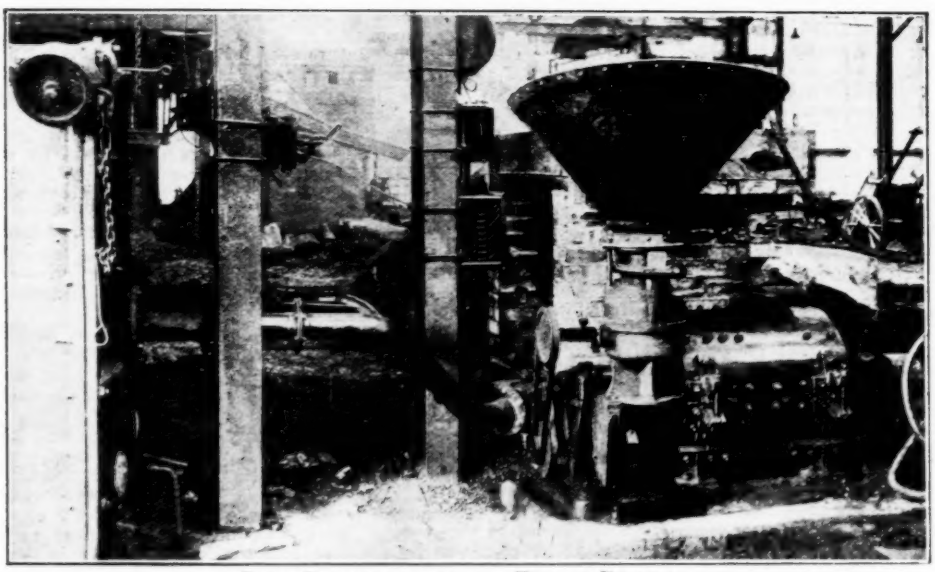
METAL MOULDS IN THE FOUNDRY.—There appeared in Table I. on page 12 of the last issue a mistake in the combined carbon content of chilling irons; this should read: (1) 0.84; (2) 0.90; (3) 0.81. The sulphur content of such irons, according to the author, should range between 0.05 and 0.06 per cent.

The Turbo Pulveriser.

Powdered Fuel Firing as a Self-contained Unit.

On a recent visit to the Sheffield Works of Messrs. Edgar Allen & Company, Limited, our representative saw a turbo pulveriser operating in connection with a first-heating furnace in the forge. It may be mentioned at the outset that the furnace in question was converted from coal-firing to firing with powdered fuel without the necessity of any structural alterations being made. The furnace chamber is 10 ft. × 6 ft. × 2 ft. 9 in. high with a 3-ft. length of firebox, to the rear of which last the fuel feed connection is made, the old firebox now serving as a combustion chamber.

While the number of turbo pulverisers at work in this country is not large, in the last year or so over 200 have been installed on the Continent for firing metallurgical furnaces of a very varying nature, and also steam boilers. It is interesting to note that at Messrs. Schneider et Cie.'s works at Creusot, which were visited by the Members of the Iron and Steel Institute at their Autumn Meeting, these machines were giving very excellent results on continuous-heating furnaces.



TURBO PULVERISER, SHOWING FEED TO FURNACE.

Actually the unit is a pulverising mill and fan combined. It consists of a rotor on a horizontal axis revolving in a steel casing, the whole machine being self-contained and mounted upon a cast-iron baseplate. The steel casing is divided into compartments, that one nearest to the delivery containing a blowing and exhausting fan, and other compartments containing paddles fitted with loaded blades which crush and pulverise the coal in stages, pulverising by impact. The coal is fed into the end of the machine by an adjustable revolving table, the feed regulating the amount of coal burnt in the furnace. The air supply is admitted at two points. A proportion is allowed to enter at the same end as the coal by an adjustable shutter inlet, this primary air controlling the velocity of the drift through the mill and thus regulating the fineness of the powder as required. A secondary air supply is allowed to enter between the pulveriser and the fan, and this in point of fact is the carrying air for the distributing system. The air supply from the two sources may be kept below the amount required theoretically to support combustion in relation to the amount of coal used, and the additional amount of air required may be induced in the burner. But in any case, the speed of the mixture in the pipes is such that any possibility of back-firing is eliminated.

The furnace under notice is used for heating 10-in. ingots of special alloy steels, with which soaking is, of course, so very essential. Prior to starting up the present plant the furnace burnt 12 cwt. of best coal per ton of ingots heated. The pulveriser is at present using a fine slack containing approximately 23 per cent. of ash and some 10 per cent. of moisture, and of this the consumption per ton of ingots heated is only 3½ cwt. The plant is driven by a 10-h.p. motor, and careful records taken of the actual running costs show the cost of energy to be no more than 8s. 8d. per eight-hour shift. When firing with coal the fire had to be banked through the night; no such banking is now done, but on restarting in the morning a heat can be got out in a couple of hours, or from the stone cold in three hours. The bulk of the ash appears to settle down in the combustion chamber, with the particular slack used, in the form of a fine dust.

Firing with powdered fuel under the conditions specified should have an important future, as its adoption does not necessitate the laying down of an expensive plant for pulverising, drying, and distribution; but as a self-contained unit it is within the reach of even the small concerns to whom indeed it cannot fail to appeal on the basis of economy. Fine slack is, of course, the cheapest class of fuel, and it is at the same time the most suitable for use in the system, as the finer the material fed the less power will be required to drive the plant with a corresponding reduction of wear upon the pulverising members.

If the fuel is suitable in other respects there are no restrictions as to the ash content, other than commercial ones, for whilst fuels with an ash content so high as to make them almost valueless for other purposes can be employed in the powdered-fuel system of firing, it must be borne in mind that the use of such a fuel entails power consumption and wear on the plant to pulverise the ash, which is of course useless in regard to the production of heat.

Naturally a fuel reasonably high in volatiles is most desirable owing to the ease with which it lights up on starting; at the same time we are informed that the turbo pulveriser is working successfully with coal of which the volatile content is as low as 7 per cent.

No difficulty is experienced in dealing with fuel of the ordinary moisture content, such moisture being converted into vapour by the heat generated in pulverising and blown in this form into the combustion chamber. In this it will be seen that the system differs from all other methods of burning powdered coal, and is only possible because no powdered coal is stored nor is the coal passed through fine screens.

The suppliers of the plant are The Powdered Fuel Plant Company, Limited, of 47, Victoria Street, London, S.W., who are closely allied with Messrs. Stein & Atkinson, Limited, Victoria Street.

Recarburising Steel for Iron Foundry Use.

For the series of trials which was made at Rombach a cupola of about 37½ in. diameter was used. It was charged with two tons of coke to 7¾ in. above the tuyeres. After the blast was put on more coke and 350 lb. burnt lime was charged. Then charges were put in of 1,100 lb. structural steel scrap, 200 lb coke, and 66 lb. lime, and, with the first five tons scrap, 900 lb. of 10 per cent. ferro-silicon was charged. About three times the usual amount of slag was produced. This was acid, and gave SiO_2, 44 per cent.; CaO, 33 per cent.; and 20 per cent. Al_2O_3 and Fe_2O_3. The first tap of 5 tons had the following analysis: C, 2.80; Mn, 0.22; P, 0.21; S, 0.12, and Si, 0.75. Of the added silicon, 95 per cent. was found in the metal, and some was found in the following cast, so that the loss was not important. Another run was made with no ferro-silicon, but more lime. When tapping 110 lb. of 75 per cent. ferro-silicon in lump form was added to the ladle. The metal was cast in three beds, and sampled separately to ascertain if the metal was homogeneous. The results are shown in Table I.:—

TABLE I.—*Analyses of Cupola Melted Steel Scrap.*

Cast No.	Si.	Mn.	Ph.	S.	C.
1 ..	0.60	0.15	0.11	0.12	2.90
2 ..	0.67	0.16	0.16	0.11	2.95
3 ..	0.70	0.22	0.13	0.11	2.70

The experiment had to be curtailed because the shell of the cupola about 20 in. above the tuyeres was red hot. The cupola was afterwards lined with ladle bricks, the coke charge raised, the throat made smaller, for the purpose of increasing the surface contact between iron and coke. Also heavier scrap was used, which would not melt quite so quickly. The coke used contained 8.74 per cent. ash. In the re-lined cupola about 25 tons of billet ends were melted in one shift and tapped in eight casts. To casts 1, 2, 7 and 8 528 lb. of 10 per cent. ferro-silicon were charged in the cupola; and to casts 3 to 6, 77 lb. of 75 per cent. alloy were added to the ladle. The analyses are shown in Table II.:—

TABLE II.—*Analyses of Cupola Melted Billets.*

Cast No.	Si.	Mn.	Ph.	S.	C.
1 ..	0.82	0.22	0.12	0.30	2.75
2 ..	0.52	0.29	0.13	0.27	3.20
3 ..	0.84	0.19	0.13	0.22	3.20
4 ..	0.84	0.17	0.12	0.18	2.70
5 ..	0.80	0.20	0.20	0.24	2.90
6 ..	0.79	0.18	0.14	0.21	3.35
7 ..	0.53	0.25	0.08	0.17	3.20
8 ..	0.30	0.25	0.08	0.17	3.15

Slag was abundant, although not so much as in the previous runs. The analyses of the slags from the fifth and seventh casts are shown in Table III.

TABLE III.—*Analyses of Cupola Slags.*

Cast No.	SiO_2	CaO	Fe_2O_3	Al_2O_3
5	35.6	24.0	22.6	18.3
7	40.1	27.9	12.2	18.0

As the iron was too sluggish about 1 lb. of aluminium was added in each foundry ladle. The iron ran freely and filled the moulds satisfactorily. The charge was composed of 26 tons scrap, 11 tons coke, 2 tons lime, 1 ton 10 per cent. ferro-silicon, 308 lb. 75 per cent. ferro-silicon, and 9 lb. aluminium. The brick lining was badly eaten away. This factor, together with the high coke consumption, and above all the increase in sulphur, notwithstanding the high lime charge, prevents this process being a success. The high coke consumption is due to the difficulty of melting low carbon steel scrap and the high sulphur comes directly from the coke.

If the coke consumption could be seriously reduced then simultaneously all these difficulties would be removed. Liquid low carbon metal was available from the steel works, and, if the whole could be charged with molten iron, the whole burden of melting would be removed, and only the carburising remain. On this hypothesis was based the following experiment. The first test was carried out in a pipe about 6½ ft. long and 3 ft. 3 in. diameter, lined with one layer of ladle brick and provided with a bottom and a tap hole. Before each test a fire was made, the whole pipe filled with coke, and the whole blown as hot as possible. Molten low carbon basic Bessemer metal was then poured into the white-hot column of coke in the pipe. In order to prevent pits being formed in the coke the ladle was moved slightly during pouring, and coke thrown continuously into the stream of metal.

During the pouring, or shortly before, ferro-silicon and manganese were added. Five minutes after the filling with the 5 or 6 tons of molten metal the tap hole was opened and the metal teemed into the moulds. The resultant iron was examined chemically and microscopically to ascertain whether the carbon was really combined, and not simply mechanically mixed with the iron. The results on several casts are shown in Table IV.

TABLE IV.—*Showing the Analyses of Liquid Steel run through a Column of Coke contained in a Pipe.*

Si.	Mn.	Ph.	S.	C.
0.07	0.24	0.05	0.08	1.95
0.60	0.53	0.15	0.08	1.70
0.80	0.58	0.19	0.09	1.70
0.36	0.53	0.10	0.08	2.52

Similar results have been obtained with the similar tests carried out over a period of eight months. Only traces of mechanically included carbon have been found. The iron is extremely tough and shows a martensitic structure. The increase in phosphorus is interesting. An investigation showed this came from the slag carried over by the metal.

These experiments show that the metal must be hot and fluid, and the coke column thoroughly heated. There is then no danger of the metal solidifying inside the coke column.

From the experience gained a furnace was built near the foundry ladle track similar to a cupola. At the charging floor level the furnace was equipped with a large door for charging coke on one side, and on the other side with a launder for the molten metal.

The furnace was provided with two sets of tuyeres and oil burners, through which blast could be blown for heating the coke. A receiver of about 25 tons capacity was provided. This was heated with two tar-oil burners. In front of the taphole lay the casting bed.

The *modus operandi* is to heat the receiver, the hot gases from which ignite the coke in the shaft. As soon as the receiver and column of coke are sufficiently hot, a ladle of basic Bessemer steel is brought along and slowly poured down the launder, the charging door being kept closed. The metal runs down into the receiver where it is mixed. Sometimes the process is carried out with the receiver taphole open, so that the metal simply flows through it, but even this gives a uniform

TABLE V.—*Typical Analyses of Recarburised Bessemer Steel.*

Si.	Mn.	Ph.	S.	C.
0.04	0.27	0.08	0.08	2.54
0.24	0.36	0.07	0.08	2.74
0.14	0.37	0.12	0.08	2.80

metal, the difference in carbon between the first and last cast being only 0.20 per cent. As soon as the metal is cast the shaft is refilled, and the furnace prepared for the next cast. Metal made in this way contains usually 2.6 to 2.8 per cent. carbon, and corresponds to the so-called low carbon special iron. Typical analyses are shown in Table V.

TABLE VI.—*Showing Bessemer Steel Recarburised with Charcoal.*

Si.	Mn.	Ph.	S.	C.
0.06	0.49	0.11	0.04	1.90
1.13	0.43	0.15	0.04	1.95
3.54	0.45	0.15	0.02	2.55
1.00	0.47	0.14	0.04	3.05
0.05	0.30	0.09	0.06	3.56
0.19	0.75	0.12	0.02	3.25
0.08	0.36	0.07	0.02	3.20
0.18	0.58	0.05	0.03	3.30
0.08	0.41	0.08	0.06	3.40

The great toughness of this material is due to the metal being carburised at comparatively low temperatures.

This method can be used for producing an iron similar to cold-blast charcoal iron, by replacing the coke column with charcoal. Generally speaking the metal produced with charcoal contains 3 to 3.5 per cent. carbon. Typical analyses are given in Table VI.

The resultant pigs were generally blistered, but were tough and similar in every respect to the special charcoal pig-iron described by Graham-Otto in his German "Handbook of Chemistry."

Comparative tests made with the Rombach synthetic pig-iron produced as described above and with Swedish charcoal pig-iron (Brand S.L.) disclosed the following facts:—

(1) Taking the casts either individually or the whole series when mixing the two brands together, more or less of either brand did not in the least affect the final result.

(2) If it is a question of substituting the Rombach iron for Swedish charcoal iron, this may be done with impunity, one brand being just as good as the other.

(3) The Rombach iron may therefore be used more extensively as a substitute for Swedish iron.

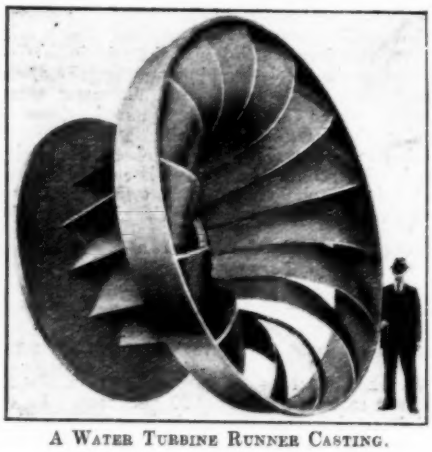
(4) The final verdict must, however, be postponed until the Rombach iron has been manufactured and used on a much larger scale for specially important castings. A recommendation of the Swedish iron is its regularity and uniform quality, which is steadily maintained in consignment after consignment for a long period.

(5) A serious drawback of the Rombach iron is its spongy and rough appearance. Attempts should now be made to invent a process that will get over this difficulty.—"Stahl u. Eisen."

A Large and Intricate Steel Casting.

We are indebted to Messrs. Boving & Company, Limited, water-power and hydraulic engineers, of 56, Kingsway, London, for the loan of the accompanying illustration. This should be of great interest to all steel founders in that the steel casting shown is the largest water wheel ever cast in one piece.

The particulars and principal dimensions are as follows:—7,700 b.h p. runner for spiral-casing type



A WATER TURBINE RUNNER CASTING.

water-turbine acting under a water pressure of 31 ft. and running at a speed of 83 r.p.m. The outside diameters at the bottom and top are 13.5 ft. and 11.0 ft. respectively. The height from top to bottom is 8 ft.

A glance at the illustration will show that the moulding of this casting was in itself no easy task, and, when taking into consideration the large surface, the comparatively thin section of the metal, and the distance through which the metal had to be run, the difficulties of casting will be appreciated.

Australian Aluminium.—Various deposits of bauxite are being investigated in Australia. The best of these are said to show alumina contents equal to the American standard, but special attention is being devoted to ore from Wingello, near Moss Vale, in New South Wales.

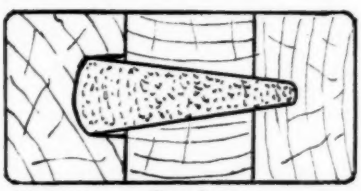
The Patternmaker's Oil-stone.

By J. DRINKWATER.

The quality of an oil-stone is very important, but an inferior stone in good order is much better than a first-class stone that is neglected. It is quite impossible, for instance, to get satisfactory results from a cracked stone or one with broken edges.

There are several kinds of natural and artificial stone on the market, but to rub up a keen, fine edge on carving gouges or thin chisels there is no stone equal to Arkansas. It is expensive, of course, and is usually made for gouge slips. It is hard and the grain is fine, therefore it is slow. Washita stones are coarser and cut more rapidly, but they are very unsatisfactory. The best known of the artificial stones is Indian oil-stone, which is made of Indian corundum. There is a good deal of unreasoning prejudice against artificial stones, but a great deal can be said for them. There is more choice of form and grade, and a commendable feature is that a stone can be obtained with one face coarse and the other fine. Some like this because a coarser stone is needful for turning tools. In this respect it may be said that it is nearly impossible for a patternmaker to keep his stone in condition if he uses it for bench and lathe. A flat face is not as important for turning tools.

The apprentice should cultivate a habit of levelling his stone once a week; after a week's usage the unevenness may be almost imperceptible, but it is there, and one or two rubs on a sheet of emery paper suffice to keep it in condition; the emery paper being placed on a saw or other



SECTION OF A BOX SUITABLE FOR ENCLOSING AN OIL-STONE.

machine table. This is certainly better than waiting until there is a 1/16-in. hollow in the centre of the stone and then rubbing it out. With the advent of the sander into pattern-shops the slow emery paper method is frequently dispensed with, but it is certainly better than the sander, on which it is nearly impossible to get a true surface, in addition to which there is the danger of burning.

Choosing a Stone.

A broad stone is always preferable. With regard to quality, appearance does not always count, but usually it can be ascertained whether a stone is fine or coarse by lightly pressing the finger along its surface. A good stone should be uniform throughout, and soft places can be detected if a moist sponge is placed on the stone because they absorb the moisture more quickly.

The Question of Oil.

With regard to the oil that is used in sharpening, any oil other than linseed is quite suitable. Linseed oil clogs the pores. Sperm is held in great favour by some, but ordinary sweet oil is equally as good. Olive oil, if it is to be obtained, is very satisfactory.

Gouge slips require as much consideration as the flat stone, and it is well to have two or three different sizes. It is very seldom that slips are put into a case, but it is as advisable with them as with ordinary stones. Oil-stone boxes are sometimes coated inside with white lead and the stone bedded in, but there is no apparent gain from making a stone a fixture. When it is composed of two different grades it is essential that it be removable, and in all cases it is advisable. It should certainly be a tight fit, and a cover should be fitted to keep dust out. Iron stands which grip the stone have become very popular in recent years, but the writer prefers the old-fashioned wooden case. In order to keep them clean, and in addition prevent them from being knocked off the bench and broken or lost, slips should also be enclosed in cases. The accompanying illustration shows a section of a suitable type of box, which is best made of hardwood.

Drop Prints and their Cores.

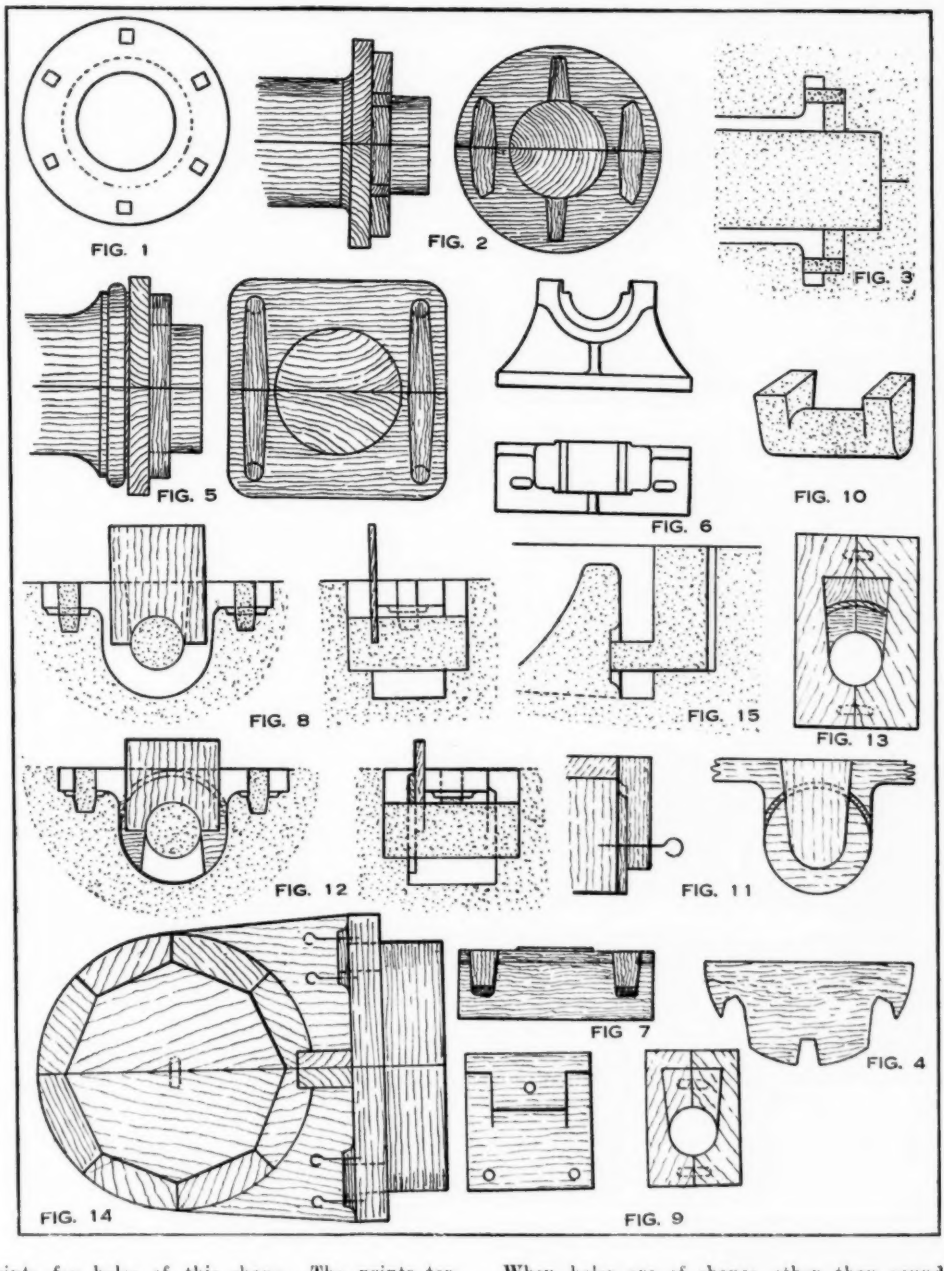
BY JOSEPH HORNER.

This subject is of high importance, because these cores are used in large numbers in all classes of work, jobbing and repetitive, and because slight differences in the provisions made for them will total to gains or losses that are of considerable magnitude when numbers of similar castings are required.

Fig. 1 is a pipe flange with square bolt holes, and Fig. 2 is the common method of fitting drop prints for holes of this shape. The prints terminate in the lower portion of the core outlines. The insertion of the cores is shown in Fig. 3. They may be stopped-over by laying a strip of wood, having its lower end cut to fit over the core, and held against the mould space, while the space left by the print impression above the core is rammed and made good with sand. If work is repetitive the core, with the portion for stopping-over, is made in a box.

A method which is sometimes adopted for occasional jobs is to insert the cores without the guidance of print impressions, using a templet, Fig. 4. The cores are rubbed to the neat length of the flange thickness, and pushed down into the mould, and their positions are set by the templet, without stopping-over. The friction of the cores against the mould sides is sufficient to prevent them from becoming shifted during pouring. A spot of clay wash, or a nail, is sometimes used as additional security. These templets are stocked by scores in the jobbing pipe shops. But the core prints are used on all standard patterns.

Fig. 5 shows drop prints for round cores on a column foot, the cores to be stopped-over with or without a box. Fig. 6 is a bearing with slot bolt-holes in its foot. Fig. 7 is the pattern foot with its prints. In this, as in other cases, the lower ends of the prints indicate the shapes of the cores.



When holes are of shapes other than round or square, and no core box is provided, the shape of the core is often indicated on the print, as shown in Fig 7.

Fig. 8 is the mould for a common bearing, with a stopping-over piece, embracing a core, in readiness to have the sand rammed over the core, and between the face of the board and the open space left by the drop print. The drawing shows two round cores for bolt-holes already inserted.

Since the work of stopping-over is tedious when castings are numerous, and since there is a slight risk of inaccuracy creeping in, due to shifting of the core, or to sand tumbling into the mould, or adjacent sand being disturbed, a core box, Fig. 9, is preferred for repetitive work. It includes the

print impressions and the core, Fig. 10, and fills up the spaces left by the drop prints at the same time that it forms the hole.

This provision is of even higher value in cases where the faces of the casting are not plane, but carry bosses, and when more than one core occurs in a vertical plane. Thus, in the example, Fig. 11, which is similar to that in Fig. 8, but with the addition of facing bosses, the usual provision made for stopping-over is either to cut the print to fit over the boss, as shown, or to cut out the boss to fit round the print. The latter is better from the point of view of stopping-over, which is shown being done in Fig. 12. Here the boss, shown as cut to fit round the print, has been taken off the pattern and inserted in the mould upside down, giving a correct face for the stopping-over piece to lie against during the filling. If the boss is not cut thus a special boss for stopping-over has to be supplied by the pattern-maker. A better plan is to make a box with the inclusion of as much of the boss as is covered by the print, as seen in the end view, Fig. 13.

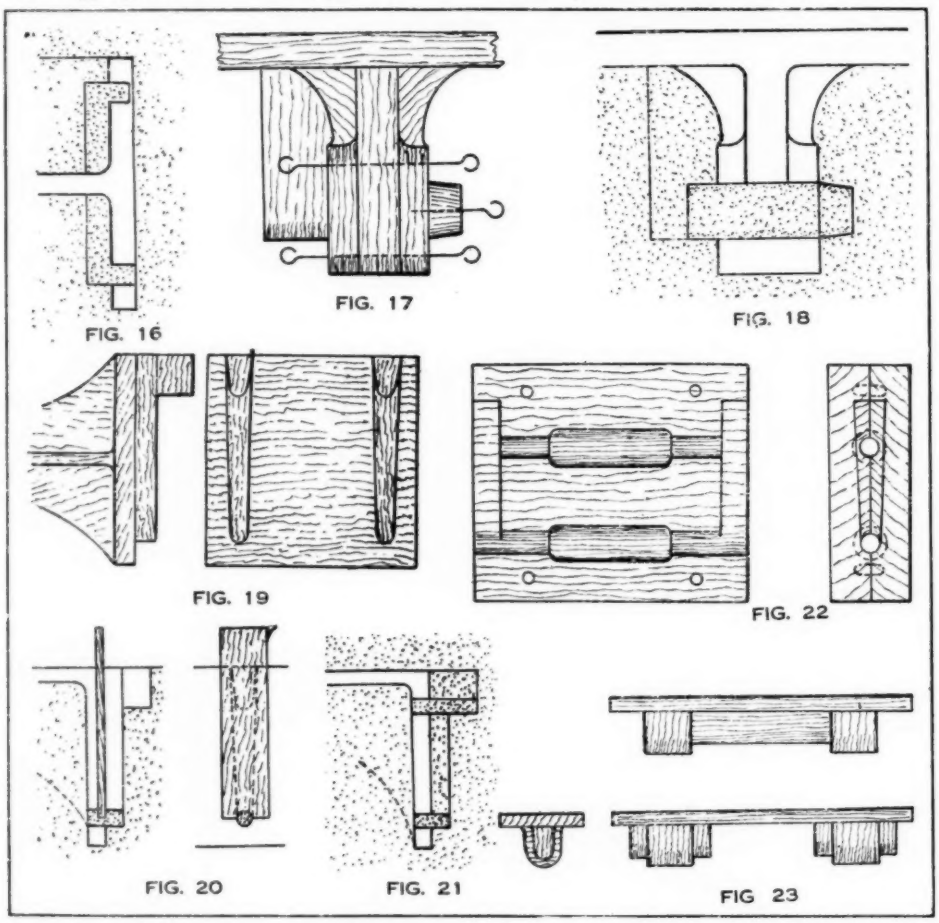
When bosses occur on the inner side of a pattern, as in Fig. 14, instead of next the prints, then it is necessary to have the cores cut long enough to be thrust into the bosses. This becomes awkward when the bosses are thick, since the cores may not be located exactly central with their faces. In such cases the core should be made in a box to stop itself off. It has then to be pushed along bodily by an amount equal to the boss thickness, Fig. 15, leaving a corresponding space behind to be filled with sand.

Generally, it is better to put prints on the outer faces of feet than within them. The cores then are close to the sand in the top as well as in the bottom. The reason is seen in Fig. 16. Cores have been inserted from within. As the sand in the top has to pass down over the end of the upper core, it will be liable to become fractured unless a little is filed off its end, as shown, to afford a safe clearance. This will be occupied with metal, to be broken through.

For some shapes, where bosses are very thick, it is better to combine a round, with a drop print, illustrated in Fig. 17. Of course, if this bracket stood alone, it would be moulded sideways with a round print only. But being part of another pattern, which compels the moulding with the bosses down, the method shown is the proper one to adopt. Comparing this with the mould, Fig. 18, it is seen that the drop print is made of extra thickness to permit of sliding the core along into the impression of the round print. Afterwards the space left behind is stopped over and filled up.

Another case is that of the superposition of holes in a vertical plane. Fig. 19 shows the end of a foot for a pattern bracket, having provision made for coring four bolt-holes. The deep prints are for the two lower holes—the short prints for the upper holes are superimposed. This involves stopping-over in two stages, and the upper cores are very liable to be tilted, consequent on their overhang, which is the reason why the thickness of their prints is increased over that of the others, though not by an amount equal to the overhang. This method, though frequent, is not the best. What it means is seen in Figs. 20 and 21. In Fig. 20 the stopping-over of the lower core is shown. In Fig. 21 both cores have been inserted. The depth of sand is objectionable, as well as the filling up of the core print above. Holes cored thus are very likely to come out of truth. For all work of this kind, and particularly when the thicknesses are great and the mould deep, it is much better to make both cores in one box, to stop themselves over. For such a core only one print is required.

When, instead of going through a thin web or plate, cores have to pass through a great thickness of metal, they are supported in print impressions at both ends. In such cases the making of a box is most desirable. Fig. 22 illustrates an example of this kind, in which the cores, being long, are recessed, "chambered" about the centre, partly in case of sag of the cores, to preserve clearance about the centre, and sometimes to lighten the metal when mass might occasion a draw. When cores have to go through isolated lugs in line, it is better to use one print as in the upper view in Fig. 23, rather than separate prints as in the lower figure.



Institution of British Foundrymen.

EAST MIDLANDS BRANCH.

At a meeting held on November 19 at the Technical School, Leicester, a Paper was read by Lieut. F. G. Skerritt on "The Electric Welding of Cast Iron and Steel."

The Branch-President, Mr. W. T. Evans, of Derby, was present, but he having lost his voice, Mr. S. H. Russell, of Leicester, deputised in the chair.

THE ELECTRIC WELDING OF CAST IRON.

LIEUT. SKERRITT hoped the members would forgive any shortcomings, as it was the first time he had ventured to address such a gathering on a technical subject.

He said electric welding had been known for 40 years, but the recent intensive development can be attributed to the war. Shortage of carbide and oxygen led in many cases to the substitution of electric arc welding for oxy-acetylene welding. The improvements made resulted in its being recognised as an engineering and commercial success, and the rapid development of specialised processes is due to the wide scope of their applicability.

Oxy-acetylene and electric welding should not be regarded as replacing one another, but as supplementing each other, and both processes were used by the author. Electric welding can be placed in two distinct groups, one producing heat by the resistance of the metal being welded to the passage of the current, and the other by using the heat of the electric arc. They are known as resistance welding or sectional welding, and arc welding or surface welding. The differences rest entirely on methods and special applications. In arc welding the heat is localised through the action of the electric arc, and no pressure is applied. In resistance welding the heat is localised by the resistance to the flow of the current and pressure is applied. The contact or resistance method can be termed a proper welding process, and the other more correctly described as autogenous welding by the electric arc.

The methods of using resistance welding are butt, spot and seam welding; and of arc welding by the carbon electrode and the metallic electrode, the latter sometimes bare and sometimes covered.

Resistance Welding.

The process of resistance welding is based on the fact that a poor conductor of electric current will heat if current is forced through it, or that a good conductor will heat if enough current is passed through it. The resistance method is the simplest, and is limited almost exclusively to new work and to articles of moderate size, although later developments have made heavy steel members a practical proposition. The operation consists mainly in clamping the pieces in a machine, passing a heavy current through the area of contact until it becomes plastic and then squeezing the pieces together to form a weld.

Cast iron cannot be commercially welded by this method as it passes suddenly from crystalline to fluid state when at welding temperature. With steel or wrought iron the temperature must be kept below melting point to avoid injury to the metal. The metal must be heated quickly and pressed together with sufficient force to push out all burnt metal from the joint. High-carbon steel must be annealed after welding, but nickel steel welds readily, increasing the strength. When welding copper and brass pressure must be less than when welding iron, current is cut off the instant metal begins to soften and pressure applied.

Butt welding consists of bringing two pieces of metal in contact end to end or side to side, and then clamping the ends between two heavy copper jaws supplied with a large current at low voltage. The metallic surfaces should be of practically the same cross section. A slight burr is formed at junction, and weld is finished off by hammering. The current is generally alternating single-phase. Electric welding can be used for bars, chains, tyres, frames, wires, and the like.

Spot Welding.

Spot welding is a modification of butt welding used for joining sheet metal. Plates to be joined are placed between electrodes through which a high current is passed while pressure is applied. Intensity of current produces a rapid rise of temperature which, combined with pressure, tends to prevent oxidisation in the weld. The appearance is similar to flush-riveted welds. By replacing pointed electrodes with mechanically-driven electrodes, continuous seam welding can be carried out, and this form of continuous welding machine is becoming increasingly popular for joining metal sheets to form cases, drums, trays, etc. Heavy spot welding is in an experimental stage.

Carbon Arc Welding.

The characteristic principle of carbon arc welding is that an electric arc is held between the metals to be joined, and this forms one electrode of the circuit and a carbon rod or pencil manipulated by the welder which forms the other electrode. By placing the carbon electrode in contact with the metal, thus closing the circuit and instantly withdrawing it again, an electric arc is formed between the two electrodes, and owing to the high temperature of the arc the metal is melted. Experience has shown that the metal to be welded should be the positive electrode and the carbon the negative electrode. If this order is reversed a shorter arc is obtained, and particles of the carbon rod can enter the molten metal and cause brittleness. Cutting can be done by carbon arc, but few operators can follow a sharp line, and the arc leaves a very rough edge. Direct current is used of from 60 to 90 volts, and from 250 to 600 amperes according to thickness of metal.

Metallic Arc Welding.

Metallic-arc welding is a modification of the carbon-arc welding. The process is better for the operator, for the electrode is only 3-16 inch, and the welder has one hand free in which to hold a protecting screen.

Arc Burn.

It is very painful if the rays reach the eyes either directly or reflected; the symptoms do not show at the time, but arise about six hours later, and the inflammation remains several days.

A low voltage is required as in the carbon arc, but current is reduced to 50-175 amperes. The electrode usually supplies the filling material.

Protection for the skin as well as eyes is necessary in all arc welding. A wooden or metal screen fitted with coloured glass and large enough to protect forearm, face and neck is desirable, the right hand being gloved, while in addition a helmet is worn against reflected light.

Covered Electrodes.

Practical tests have shown that welds with bare electrodes lacked ductility and resistance to shock, but much useful work is done, and the cost of electrodes is less than half, and the time occupied as two is to three. Covered electrodes permit the electro-magnetic effect of the welding current to act upon the molten metal; it applies flux to the weld at a rate that adjusts itself perfectly to that of the melting of the electrode and imparts to the deposited metal certain desirable characteristics. The electro-magnetic action is in effect the propulsion of the molten metal from the electrode toward the molten metal in the weld, thereby thoroughly uniting the metal to be welded and the deposited metal from the electrode. There are possibilities of defects at the junction of old and new layers and also when new electrodes are inserted, but a really skilled operator can overcome these difficulties, weld perfectly vertically and overhead, and in any position bring the slag to the surface.

Welders require a great amount of training, and the idea that the operation is simple is responsible for many disappointments. No welder should regard a job as impossible, though whether it will pay is often a determining factor. A good welder must be something of a boiler smith, engineer, electrician, moulder and draughtsman. It is often necessary to know the cause of the breakage; it is not fair to a customer to weld a piece that is of too light a section.

Electric welding should be considered as supplementary to and not supplanting oxy-acetylene welding. The latter is generally more suitable and economical on repairing small jobs and electric welding for heavy work. Record advances in the use of arc welding are in application to constructional work, roof trusses being welded instead of rivetted, but many people are unwilling to risk a new method without the guarantee which time alone can give. It is suitable to fastening the steel skeleton for reinforced concrete. One very important advantage of welded joints is that for oil- and water-tight structures. As compared with a rivetted joint a welded joint is water-tight up to its breaking point. Ship and marine boiler repairs figure largely in the work done with large masses of metal, and much money has been saved. Arc welding for boiler repairs is now standard; all kinds of worn machine shafting can be reinforced and machined down to the original size. Tramways can effect more economy by using electric welding on such things as the side frames of tramway bodies, meter frames, the building up of worn bolt holes, armature shafts and on the track.

Many successful repairs to cast iron have been made with steel electrodes, no effort being made to deposit cast iron. With this method of welding the amount of heat applied at the weld has been found less than with any other method, and therefore extensive strains and contraction cracks are avoided. This is a most important point in cast-iron welding. It enables cast iron to be welded *in situ* and without pre-heating.

In conclusion, Lieut. Skerritt mentioned a number of repair jobs undertaken by his firm and, passed round samples of electrodes. An interesting job, he said, was to weld a crank-shaft with a three-fold fracture. It was in a cellar three storeys down; a 26-h.p. motor had to be carried down to drive a dynamo. This job cost £56, and had stood two years, and without this method the main shaft, weighing 5 tons, would have had to be removed.

THE DISCUSSION.

Asked as to cost, the lecturer said he had worked out a calculation of 5*s.* per cubic inch. He had worked out this on actual jobs, and found that for jobs *in situ* the basis is under the mark, for jobs in the shop it is well over the mark.

MR. BAILEY asked whether for the electric welding of cast iron the material had to be pre-heated.

LIEUT. SKERRITT referred Mr. Bailey to the three pieces of cast iron exhibited, which were simply cast iron deposited with a specially prepared electrode of mild steel which deposits cast iron. In welding with such an electrode it is necessary always to pre-heat in exactly the same way as it is necessary to pre-heat for oxy-acetylene welding. All the other samples shown where steel has been deposited on cast iron had been effected cold.

MR. BARRETT asked about the welding of copper and brass.

LIEUT. SKERRITT said he had no experience, but was advised a process would shortly be marketed. Heavy castings could be welded by the electric arc without pre-heating, using a mild steel q.a. or other specially prepared electrode. The carbon arc process was generally considered appropriate for filling up large blow-holes in heavy castings.

Answering further questions, LIEUT. SKERRITT said with reference to welding cast iron assisted by inserting steel pegs on either side of the Vee he would not guarantee a water-tight or pressure-tight job if he had to rely for the soundness of the job on steel pegs alone; he would require, in addition to that, perfect amalgamation of the deposited steel with cast iron.

A MEMBER said he maintained they could get water-tight and pressure-tight joints without amalgamation of the metal.

MR. BENTLEY, President of the Leicester Association of Engineers, proposed a vote of thanks to the lecturer. He had been experimenting with oxy-acetylene welding, and there was no doubt difficulties exist which are easily overcome by the electric process.

MR. CLARKE (Loughborough) seconded, and in reply LIEUT. SKERRITT said he was grateful to know he had interested them in his address on such a subject.

COVENTRY BRANCH.

A Paper on "Mechanical Tests for Cast Iron"* was read before a meeting of the Coventry Branch on December 7 by Mr. F. J. Cook. The occasion was a joint meeting with the Coventry Engineering Society, and a good muster of members of both bodies were present. Mr. E. Carey Hill (Branch-President) was in the chair, and extended a hearty welcome to Mr. Cook and to the members of the visiting Society.

THE DISCUSSION.

THE PRESIDENT, in inviting discussion, said they had heard a very interesting lecture, and it had been an admirable demonstration of many of the scientific methods employed in measuring qualities of cast iron by mechanical tests.

Transverse or Tensile Test?

MR. HARLEY said that the lecturer had always been ready to place the results of his investigations at the disposal of the Institution. Cast iron, of course, was a very complex substance, and the conditions which caused variations were innumerable. The problem was to find some method whereby the conditions for any particular line of work could be stabilised and kept constant from day to day. With regard to the most important physical tests—the tensile and transverse tests—a great deal had been said as to the best method of taking them. With heavier classes of work, doubtlessly it was very satisfying to an inspector to see the test-piece on the casting and then to see it broken off and tested. But with automobile work that condition was very difficult, because a majority of the castings were so small, and other factors would make this practice a nuisance. What would have to be done was the standardisation of methods of making such test bars. Every detail in regard to the method of moulding and casting test-bars should be definitely established. Whether it was actually the best method did not so much matter. What they should have was a comparison between one iron and another, and between one foundry and another. This could only be done when the same methods were universally adopted. Obviously, there still remained the problem of whether these results corresponded to the castings under examination. In his opinion, it was almost impossible to guarantee the life and capability of any castings from a test-bar, but it would give some idea, particularly if a sufficient number was taken, of the quality of the metal. However, in a mould there were other factors which operated either to make the casting a good or a bad one. The question of the ramming of the mould, of the amount of moisture therein, the condition and the kind of sand, and the method of running were amongst these factors. Additionally, there was the casting temperature. Dr. Longmuir had proved that the casting temperature had very striking results on the strength of the metal. But he would like Mr. Cook or Dr. Longmuir to tell them whether there was any exact workshop method of judging the temperature of molten cast iron. He had tried a good many methods, but had not yet found a satisfactory one of indicating some of the small differences in temperature such as were shown on the chart. With regard to the "hardness" chart, where combined carbon, sulphur and manganese were shown, some remarkable variations were obtained in hardness. He (Mr. Harley) would like some expression of opinion from Mr. Cook as to whether, if a foundryman had to choose between a transverse or a tensile test, there was anything which favoured the one more than the other, and which was the more valuable. There was a very general consensus of opinion that the transverse test was the more suitable, but against this he quoted his experience that he had never been able to obtain two transverse tests which came out similar, even though the conditions, as far as it was humanly possible to ensure them, were the same. As to how or in what measure test pieces represent a cast, or the quality of a number of castings, a great deal would still have to be left to the honesty and ability of the foundryman. With regard to the Brinell hardness test, he agreed that

* This Paper has already appeared in Vol. XXIII., p. 132 of THE FOUNDRY TRADE JOURNAL.

this test was not of much value in cast iron. But he would like to mention in connection with this test, although it had nothing to do with cast iron, that those dealing with non-ferrous alloys, particularly aluminium, would find the Brinell test very useful in indicating variations in the composition of the alloy.

Troubles through Growth.

MR. G. KIRBY, of the Coventry Engineering Society, said, with reference to Mr. Cook's mention of iron as used for Diesel engines, he had found that iron as used for superheated steam had a tendency to grow, so that it had eventually to be replaced by steel. Could Mr. Cook tell him of any particular grade of iron which he had found particularly useful for high temperatures? It might be of interest to them as engineers. As to the hardness of cylinders, and their ability to stand wear and rubbing and present a good surface to the piston, he expected that the lecturer was aware that in certain industries there was a method of rolling these cylinders in order to give an artificial surface hardness.

Blast Pressure and Casting Temperature.

MR. PLAYER, being interested in the control of blast pressures and casting temperatures, asked Mr. Cook whether he considered that the pressure was a sufficiently accurate guide to the volume of air supplied during the blow to allow the foundryman to ignore entirely the rather difficult problem of recording accurately the volume of air? He had in mind that in almost every cupola variations took place in load, and it seemed possible, although their blast pressure might remain constant owing to the make of the blower and other factors, that they might be supplying different quantities of air per minute at different portions of the blow. That point had received considerable attention in foundries, and at his works they had considered putting in a volume recording meter, but they were not satisfied that the instruments on the market were really reliable, although on the Continent expensive installations were being put down. Mr. Cook had shown some interesting charts indicating variations in hardness, and particularly in tensile strength, obtained by Dr. Longmuir with varying temperatures of pouring. Later he showed similar charts of his own, giving variations in tensile and transverse strength, and also in hardness, with varying blast pressures. He would like to know whether Mr. Cook considered his own results to be due to the variations in temperature, which are almost certainly consequent on the variations in the blast pressure. If so, the lecturer's experiments would seem to follow on the lines of Dr. Longmuir's experiments, with the difference that Mr. Cook had measured blast pressure and Dr. Longmuir the temperatures of casting. It was quite easy to make a series of tests of blast pressures, and, carefully carried out, some interesting results similar to those obtained by Mr. Cook would be available and no doubt valuable. At his works they were of the opinion that such variations were only indirectly due to blast pressure, but were directly the result of the volume of air supplied. That temperature was a considerable factor they had proved over and over again. He hoped Mr. Cook would tell them how to get sound cylinder castings, which was an important industry in Coventry. They thought the question of tensile strength was rather over-laboured by many of the experts, because they found little difficulty in obtaining tensile strengths, but experienced considerable difficulty in getting 100 per cent. of good castings.

Cast Iron for Machine Tools.

MR. P. A. SHAW, Coventry Engineering Society, remarked that he was very much interested in what was said respecting the cast iron put in American machine tools, and said it was the general practice when they had broken tools of this sort to replace them by steel. He did not think that they gave the English foundries a chance of showing what they could do in the matter of good castings for machine-tool work.

The Drill Test.

MR. BROUGHALL said that Mr. Cook's drilling tests formed an old point of contention between them. Some years ago Mr. Cook convinced him (Mr. Broughall) that Mr. Cook's method was the right one for testing cast iron, and they designed and made a machine specially for this test. The results, however, had not been so good as he had hoped for, but this may have been brought about through the machine not being designed for using large drills. Mr. Broughall pointed out one particular instance of the unreliability of this test and which the lecturer had not explained. Mr. Cook illustrated the mixture containing 0.5 per cent. of combined carbon and another mixture containing 1.2 per cent. of combined carbon, and the drill-hardness test showed that the mixture containing the smaller percentage of combined carbon was the hardest. Mr. Harley had raised an interesting point in connection with transverse test-bars. The question of standard test bars had occupied the attention of the Institute for many years.

About ten years ago a committee was appointed to deal with the matter, but that committee had evidently carried out its work on the lines of a Royal Commission, because he believed that up till now they had announced no result. His opinion, based on many years' experience, was that the transverse test-bars properly made and properly tested told them perhaps all they wanted to know.

Necessity for Several Standards.

Of course, for different classes of iron different standards would have to be adopted; for instance, a different deflection would have to be fixed for a soft iron from that of the harder iron. Their method of using a transverse bar was to cast these bars $1\frac{1}{4}$ in. square and machine them accurately to 1 in. square, and then carefully test, particularly noting the deflection. Mr. Harley had stated that if there was a variation of 1-32 in. in a transverse test-bar the result obtained would be totally different. To use test-bars made under these conditions was altogether unreliable.

Mr. Cook had mentioned Dr. Longmuir's Carnegie Research work, but he must confess that he had always entertained a certain amount of doubt about the value of this research, so far as had applied to casting temperatures. Dr. Longmuir claimed to have measured temperatures of 1,400 deg. C. during his research work, but he had never been able to find out what pyrometer was used in that research, nor did he believe there was, at that time, any pyrometer existing which would measure such a degree of temperature accurately.

Brinell Testing.

Mr. Cook had mentioned the small ball Brinell testing-machine made by Messrs. Alfred Herbert, Limited. Although very little reliance could be placed on the Brinell test of cast iron, using a 10 m/m. ball it had been found that most reliable results could be obtained on close-grained cast iron when using this special machine, which carried a ball 1 m/m. in diameter. In a recent investigation on cast-iron piston-rings for motor-car engines they were able to find three different hardnesses in the width of the piston ring. Mr. Broughall exhibited a micrograph showing this small ball impression on a piston ring which clearly demonstrated that the tiny impression of the ball covered no less than 400 graphite flakes.

Alluding to the test which the lecturer associated with the name of Mr. Oubridge, of the British Piston Ring Company, Mr. Broughall said that this particular test had been dropped quite a long time as unreliable.

THE LECTURER'S REPLY.

The LECTURER (Mr. F. J. Cook), in replying to the points raised, said a number of things had been touched upon which might be usefully known regarding tensile and transverse tests. From his experience he thought that the method of making test-bars and their size was one which would not be settled by any one specification. In reference to the casting of test-bars for a 2- to 3-ton cylinder, and also in regard to small work generally, he agreed with Mr. Harley that different methods would have to be adopted. As to the question of test-bars being cast separately, he remarked that the old fundamental principle underlying these matters was to ensure as far as possible that the conditions for these tests should be the same.

Tensile Test Preferable.

Whether the test should be that of a tensile bar or a transverse bar depended on the importance of the work. On the other hand, he thought that the best results or *the most information* had been obtained for large cylinders from machined tensile bars. The question of arriving at a specification which would give comparisons for the same class of work in different foundries was not an easy one, but it should be borne in mind that no bar would supply the actual results of the castings. Obvously it was no indication that the casting was a good one. However, if for a long period they found that the metal on a standardised test-bar cast in a definite manner gave results on the bar which closely approximated, it was safe to assume that the castings are to specification. Some people, it was true, declared that test-bars were of no use, but the only alternative they gave was the impracticable one of breaking every casting and testing it for fracture. Concerning the size of graphite plates, he had invariably found, as the results exceeded 18 tons tensile and approached 19.4, so the flakes of the graphite became larger; they were longer and very often rather wider. It was a curious coincidence, and he was dealing with the subject in a Paper which he had been asked to present on behalf of the Institution in America. Speaking of the American specification, which was taken on 1¼-in. round bar as cast, the Lecturer said he did not think this was quite satisfactory. He had only had one America bar submitted to him, and he had found it nearly one-eighth of an inch oval, which would give a different result had it been round, and so far as he knew no formulæ were available to correct irregular circular test-bars. Mr. Harley had spoken of the difference in the depth of bars and the variations in size, but it was obvious that by engineering formulæ the difference was as the square of the depth, and it would be necessary to square the difference in depth to get the proper result. All the results he had obtained were from tests made by getting away from the skin area and under the same conditions every time. The Brinell test was undoubtedly a very good one for aluminium, and he hoped they did not conclude from what he had said that he was condemning the Brinell test for every kind of work. What he stated was that it was not good for cast iron. But it was an excellent test for many things; for surface hardness, such as in case-hardened pins and articles of that sort. As to rolling surfaces of cylinder, this had been used with regard to Diesel engine liners. The question of surface on Diesel engine liners was a very important one; they required to have a perfectly round bore, because it was necessary to get an accurately fitting piston-ring to keep the cylinder case tight. Rolling, to give good results, had to be very carefully done. It also needed good metal, otherwise it became very uneven. They heard comparisons made about the engines made to-day and those of years ago, and although cold-blast iron was better than hot-blast iron, there was another factor which was often forgotten. In the old times it was not unusual when installing an engine to run it for weeks with a view to getting that high polish which produced the good-wearing properties, but to-day they had high-speed engines which were put on load almost at once. As to blast pressure and the volume of air supplied, the subject was one which required a whole evening to discuss. Extensive research was carried out in this particular field some years ago, and was available for those interested. It was generally laid down that there were two functions, one of pressure and the other of volume of air. Air volume gave efficiency or output, and theoretically the pressure required for actual working was just sufficient to keep the air in the centre of the cupola. Air would take the least line of resistance, which in the cupola was at the sides. If they did not get sufficient pressure the result might be that melting was taking place in a small area only. Sufficient pressure to keep the necessary volume of air in the centre of the cupola in order to provide the required heat for proper melting throughout the area was essential. Therefore, theoretically, all that was required was sufficient pressure to ensure that the air was well distributed, and with that the highest efficiency of the cupola was secured. By altering the pressure and carrying the idea further and getting the required ratio of volume, different results of hardness and tensile strength could be obtained. The formula was given by which the highest efficiency of the cupola could be obtained. But beyond this oxidisation was caused, and output fell, while the quality of the iron materially decreased. He did not think the results obtained were altogether due to temperature, but partly to pressure, The test which he had dealt with was sufficient to give a sound "K," and he had tested from 2 ozs. to 24 ozs. The temperature was good, and the slowness with which the melt was made was effected by the volume of air. Mr. Shaw had spoken of the metal put into American tools, but he would like to emphasise that he had not said the metal generally was bad; he only referred to the metal in this particular American bar which was referred to him. However, he believed that American cast iron was inferior to English, and this was a matter which he was dealing with in his Paper.

Drill-test Useful.

Regarding Mr. Broughall's point that his reference to the Owbridge test being somewhat out of date, as it had been dropped, he mentioned it as being one way of getting over the difficulty of the different sizes of indent and their measurement. Up to date he had a record of 48,000 holes drilled, and he had no diffidence in saying that he had pinned his faith on the hardness test if it was properly carried out. There were also many thousands of tests not recorded. Mr. Broughall's machine was a very good one, especially so for softer metals, but it did not appear to be sufficiently strong to work a large drill. The difficulty was that anything which had a tendency to whip, as is experienced with a small drill when testing strong irons (which was the fault of the "Keep" machine) reduced its efficiency. The resistance was too great for the type and power of the machine. With similar drills he had found the same inconsistencies, but with other drills and power he had been able to get consistent results, and also to get very close figures with regard to the ratio of hardness over long periods, and to cut out quite a lot of difficulties with cylinder work by that and other tests. The great trouble with transverse testing was that they had very few people who were able to diagnose their results.

MR. BROUGHALL, in proposing a vote of thanks to the Lecturer, alluded to Mr. Cook's many activities for the good of the foundry trade. Mr. Broughall referred to the important research which Mr. Cook and the late Mr. George Hailstone carried out in connection with the structure of cast iron and another important Paper on blast-volume and pressure.

MR. ELGIE seconded, and the vote, which was carried by acclamation, was suitably replied to by the Lecturer.

Cast Iron Water Pipes.

Mr. Nelson Smith, in a report presented to the Engineering Institute of Canada on the subject of the corrosion of cast-iron water-pipes, states:—"Two cells were so constructed as to provide two pieces of cast iron not in contact with each other, but both in contact with moist soils, the anode being in contact with limey silt and the cathode in contact with a clay soil, both soils being kept moist. One of these cells had an initial E.M.F. of 2.1 millivolts and the other 9.2 millivolts, which latter became 7.6 millivolts when filled with distilled water. Within the first three hours No. 1 rose 10 millivolts and No. 2 rose 40 millivolts. In about three days No. 1 had reached 14 millivolts and No. 2 63 millivolts, which were reduced respectively to 12 and to 48 millivolts after adding more water. The voltages varied for two months, alternately rising and falling. At the end of about two months, the cells having stood on open circuit, and without any addition of water, the polarity showed a reversal in both cells. Upon adding water once more, No. 1 recovered its original polarity and voltage, but No. 2 increased its negative polarity to 64 millivolts negative, while No. 1 went as high as 66 millivolts positive."

A WINDING-UP ORDER has been made against the Nechells Metal Company, Limited, 60, Mount Street, Nechells, Birmingham.

The Stanton-Hume Reinforced-Concrete Pipes.

In the year 1919 a reinforced concrete pipe-making plant was installed at Dartford for demonstration purposes, an inspection of which convinced the management of The Stanton Iron-works Company, Limited, of the important possibilities of reinforced-concrete pipes, and they immediately secured the rights of manufacture in this country. At the outset it was decided to install an experimental plant on a site adjoining the Stanton works, but for a considerable time work was confined more or less to the laboratory, to determine the best means of adapting the process to their methods, so that it was not until October of last year that pipes were manufactured on a commercial scale. Since then, however, the demand, always in excess of the supply, has increased abnormally, and the experimental plant, consisting of two machines, is now turning out about 150 tons of pipes per week, ranging from 4 in. up to 27 in. in diameter, though pipes up to 60 in. in diameter have been made on the machines now in operation, and all sizes are made in lengths of from 6 ft. to 8 ft.

The minimum commercial size will probably be 4 in., but, within reason, there appears to be no limit in the upward direction. In every instance the cost of the reinforced-concrete pipe is below that of cast iron, and in the smaller sizes there is relatively little difference in the comparative weights, though in sizes of, say, from 12 in. upwards the concrete pipes are the lighter of the two. The pipes can also be made suitable for any ordinary working pressure up to a maximum of 100 lbs. per sq. in. Owing to the smooth internal surface of the pipe frictional losses are reduced to a minimum, and, as the pipes are impervious at all pressures for which they are designed, the reinforcement, being completely embedded, is not subject to any cause of corrosion. A further important point is that, when laid, the joints are flush, so that there is a minimum frictional loss in the flow of liquid. The first uses which suggest themselves would no doubt be sewage and general drainage purposes, though naturally the scope is very much wider.

WEATHERING GROUND, WITH STANTON WORKS IN REAR.

By the courtesy of the management of the Stanton Company our representative had an opportunity of inspecting the experimental works and following the process of manufacture, a brief description of which will, no doubt, be of general interest. At the outset it may be mentioned that all materials are tested before passing into the works. The reinforcement is tested for tensile and elongation upon a Dennison machine; cement is subjected to a chemical and physical analysis, and sands are tested for silt. One obtains a better appreciation of the simple and compact nature of the plant when it is understood that the whole of the machinery responsible for the production of 150 tons of pipes per week is housed in a building 70 ft. x 20 ft.

The first step in the manufacture is the production of the reinforcement. This is built up on a collapsible drum, first spirally, then longitudinally, and finally spirally, thus completing the cage, which is withdrawn after collapsing the drum. The pipe moulds are made of light steel sheets secured by cotters and strengthened by cast-iron end rings. The end rings provide the running threads which come in frictional contact with the revolving discs of the moulding machines, and they also determine the thickness of the finished pipe. The reinforcement is placed within the mould, which is then ready for the moulding machine. The moulding machine is not an elaborate piece of mechanism; it consists of two longitudinal girders in which are mounted bearings for carrying the shafts, and upon each end of these shafts the discs are mounted to receive the moulds. The first shaft is driven by a long cone pulley so as to afford the most ready means of giving the variations in speed; the succeeding disc shafts are operated by the frictional contact of the pipe mould. Each of the machines installed is designed to carry three moulds, and each machine is served by a concrete mixer. The final arrangement, however, provides for the use of a dry mixer, from which the material will be fed to the wet mixers.

With the moulds in position, the machine is set to revolve slowly and the concrete is thrown into the moulds, where it spreads itself evenly throughout the length, completely embedding the reinforcement. The operator can readily see when sufficient concrete has been fed in. The speed is then increased. At the end of a few minutes the mould is brought to rest, and the surplus water, which by the action of centrifugal force has been expelled from the concrete, is allowed to run off. The machine is then re-started and the pipe once more spun for a few minutes. During this final process the inside of the pipe is burnished by passing a steel bar over the surface. The pipe is then ready for steaming; as a matter of fact, after the preliminary spin the mixture in the mould was so hard and dense that it was quite impossible to make an impression with the thumb on the inside surface.

The moulds are rolled from the machine on to a bogie, which conveys them into the steaming chamber, where they are steamed for some hours in a temperature of 130 deg. Fah. The moulds are stripped in a shop at the opposite end of the chamber, and the pipes stacked in the open to weather for about a month before being despatched for service.

The collars are made twelve at a time in a similar manner to the pipes, upon which they are designed to fit loosely. The inside of the collars, however, instead of, as with the pipes, being burnished, are scratch-brushed to give them a rough surface. Where possible the pipes are sent out with the collar fixed on to one end. The jointing up, however, is a very simple process, and the makers are prepared to send a skilled jointer for instructional purposes, if necessary, with every first consignment of pipes. The same process is employed for building special pipes—tees, 45 deg., angle branches, etc.—but it is also possible to employ cast-iron special pipes, or make up pieces in connection with the concrete pipes, and, where necessary, these cast-iron parts can be lined with concrete.

At the time of our representative's visit, two pipes jointed, making 16 ft. in length by 21 in. dia., remained perfectly impervious after being subject to a prolonged test of 70 lbs. water pressure. The pipes will also stand considerably more external load than stoneware pipes. Thus a 60-in. pipe, with a crushing load of 8 tons 12 cwt., took a momentary deflection of $\frac{1}{4}$ in. and a permanent set of $\frac{1}{8}$ in., whilst it required a dead load of 15 tons to fracture a 6-in. pipe. For the purposes of the crushing tests the dead load rested on a round 2-in. bar placed longitudinally on the pipe.

Trade Talk.

JOHN LYSAGHT, LIMITED, have removed their London office to Imrie House, 33-36, King William Street, E.C.4.

DURING THE TWELVE MONTHS ended March 31, 1921, British India exported by sea 779,842 tons of manganese, as compared with 382,116 tons in the previous twelve months.

MR. J. SIMONS has been appointed by Guest, Keen & Nettlefolds, Limited, to the position of general manager of their Cardiff-Dowlais works in succession to Mr. A. K. Reese.

A RECENT ISSUE of the "Gazette" contains an order of the Board of Trade determining that a census of production shall be taken in 1923 in respect of the production of the year 1922.

BANISTER, WALTON & Co., LIMITED, inform us that in future the whole of their business will be transacted at offices adjacent to the works in Ashburton Road, Trafford Park, Manchester.

IT IS REPORTED from Berlin that an agreement has been concluded with a Chinese concern for the foundation of works at Shanghai, and of a new company which will push the sale in China of goods produced by the Stinnes firms.

GUEST, KEEN & NETTLEFOLDS, LIMITED, are erecting at the old Ivor works section of their iron and steel works in Dowlais a new power house for the generation of electricity for their local undertakings, including the collieries.

AFTER THE HOLIDAYS work was resumed last week in the shipyards of the Palmer Shipbuilding Company, Jarrow, and Messrs. Hawthorn, Leslie & Company, Hebburn. It was officially reported that a good start had been made at each yard.

MR. MASSEY, New Zealand's Prime Minister, in a recent interview, said his Government had accepted tenders from British firms for £100,000 worth of plant for the installation of hydro-electric plant for a system to supply Wellington and district.

ATTENTION WAS DRAWN at a recent meeting of the Birmingham Chamber of Commerce to the laxity of the law in permitting goods manufactured abroad to be passed on to the purchaser with indications suggesting that they were the products of British industry.

THE committee of the Scottish centre of the Institution of Electrical Engineers have decided to resume the annual dinner, which has not been held since 1913. The dinner will take place on Tuesday, February 28, at the Grosvenor Restaurant, Gordon Street, Glasgow.

DURING THE PAST FEW WEEKS eleven steamers have arrived at Buenos Ayres from Germany heavily laden with hardware, machinery, textiles, chemicals and paper. Whereas steamers from other countries arrive in Argentina partly loaded, those from Germany arrive full.

A STATEMENT IS CURRENT that the Austrian Government has allowed it to become known that Messrs. Vickers, Armstrong are offering to purchase the great Woellersdorf Arsenal, which would be converted into works for the manufacture of locomotives for Balkan orders.

IT IS REPORTED that Messrs. Burgerhout's Engineering and Shipbuilding Company, at Rotterdam, have secured an order from the Tandjong Priok Drydock Company for the building of a pontoon drydock of 8,000 tons, to be stationed at Tandjong Priok (Batavia harbour).

THE application of the steam turbine to a modern aeroplane will be amongst the exhibits at the fifth biennial Small Power Engineering and Scientific Exhibition, opening at the Royal Horticultural Hall, Vincent Square, Westminster, S.W., to-morrow (Saturday).

AN INSTRUMENT something like a doctor's stethoscope, but for listening to the internal workings of geared turbine machinery, was shown at the recent annual exhibition of the Physical and Optical Society of London at the Imperial College of Science, South Kensington.

A HELSINGFORS CORRESPONDENT states that the Soviet Government has sent 60 railway engines to Esthonia for repairs. Thanks to this order the largest works in Esthonia, the Russo-Baltic Naval Construction Yards—renamed the Anglo-Baltic Works—will now resume their activities.

THE AGENCY of John Lysaght, Limited, in the Argentine, Uruguay, and Brazil has been placed with the Anglo-Argentine Coal Company, Limited, and its associated companies, Gueret's Anglo-Brazilian Coaling Company, Limited, and Gueret's Anglo-Uruguayan Coal Company, Limited.

MESSRS. WORKMAN, CLARK, Belfast, have received orders from the Commonwealth and Dominion Line to proceed with the completion of their steamers "Port Auckland" and "Port Campbell," the construction of which was suspended early this year. It was also reported that orders have reached Messrs. Harland & Wolff to complete the fitting out of the White Star liner "Pittsburgh," 16,000 tons, and 12,000-ton "Oroya" for the Pacific Navigation Company.

AT A MEETING of the North-Eastern Section of the Junior Institute of Engineers, Mr. F. K. Skevington read a paper on "Reaction Turbines."

ARRANGEMENTS have been made for the joint conference between the Shipbuilding Employers' Federation and the Shipbuilding Trade Unions to discuss the question of the revision, or the withdrawal, of the Industrial Court's war-time bonus payments, to be held at Carlisle on the 19th inst.

FAIRS ORGANISED by the Overseas Trade Department, at which British manufacturers, excluding middlemen, will be able to show their goods to home and foreign buyers, are to be held concurrently from February 27 to March 11 in London and Birmingham, the White City being the metropolitan centre.

AN URGENT REQUEST to all industrial firms and master printers throughout the kingdom has been made by Mr. William H. Burchell, governing director of the Caxton Press, Limited, and hon. secretary of the Association of Master Printers of the London Central Districts, on the subject of high postal rates.

LICENCES have been granted under the Non-Ferrous Metal Industry Act, 1918, to Charles Barron & Company, 16, Craven House, 121, Kingsway, London, W.C.2; Charles Albert Beard, 2, Fen Court, London, E.C.3; Elias Calderbank, Orchard Street, Wigan; and Thomas Vaughan Rees, Castle Buildings, Llanelly.

THE MIDLAND COUNCIL of the National Union of Manufacturers have had under discussion the question of the Government's Overseas Credit Scheme, proposed as a trade reviver, and have expressed the opinion that the scheme will be of little use to the manufacturers because the foreign importers could not furnish the stipulated guarantees.

THE COMBUSTION ENGINEERING COMPANY, of Coventry House, South Place, London, E.C.2, are planning to start up a large foundry in the Derby area, and as they are about to place orders for its equipment, they will be pleased to receive catalogues from the various foundry equipment manufacturers. They hope to start operations in the late spring.

THE IMPORTANT ANNOUNCEMENT is made by Messrs. W. & S. Pollock & Company, engineers and iron-founders, Glasgow, that they have purchased Wellshot Brewery, Cambuslang, and are reconstructing the whole place for the purposes of an engineering works. A new foundry is being added and plans are being prepared for an extension of the existing buildings.

THE FIRST FIVE Commercial Research Fellowships instituted by the Executive Council of the British Empire Exhibition for competition among the Chambers of Commerce in the United Kingdom have now been awarded. The successful competitors are the Chambers of Commerce of London, Glasgow, Norwich, Warrington and Oldham, which will each nominate a Fellow.

PROSPECTING FOR FRESH FIELDS of ironstone was commenced in the Cleveland district a considerable time ago. The results, it is now ascertained, were very satisfactory, and the Skinningrove Iron Company, Limited, on whose behalf the experiments were made, purchased the royalty and land, required to start operations. The mine is situated near to the village of Hinderwell.

SWEDISH IMPORTS of iron and steel during the ten months ended last October totalled 114,900 tons, as compared with 214,200 tons during the corresponding period in 1920. Exports of iron and steel during the same ten months in 1921 amounted to 117,200 tons, against 230,900 in 1920. The figures for iron ore exports in the first ten months were 3,758,000 tons in 1921 and 3,263,000 in 1920.

OWING TO THE present unsatisfactory accommodation, at the request of several representative members of the Manchester Royal Exchange, an informal meeting was held on 'Change, when it was arranged that on and after January 3 the iron, steel and allied trades should occupy a position on the Cross Street Side (new extension) of the Manchester Royal Exchange, between Pillars 9 and 14, bounded by "A and B" on the Bank Street side.

DUNFORD & ELLIOTT (SHEFFIELD), LIMITED, Attercliffe Wharf Works, Sheffield; Halley's Industrial Motors, Limited, Yoker, Glasgow; Rose Patent Fuel Company, Limited, Gloucester House, Swansea; Diamond Lubricating Company, Limited, Weaste, Manchester; Alex. Anderson & Sons, Limited, Carfin Boiler Works, near Motherwell; and Robert Potter & Sons, Govan Foundry, Helen Street, Govan, Glasgow, have joined the Federation of British Industries.

HIS MAJESTY'S CONSUL-GENERAL at New York reports that the New Jersey Tunnel Commission has now invited tenders to be opened on February 7 for contracts Nos. 3 and 4 for the construction of two cast iron tunnels under the Hudson River from New York City to Jersey City. Plans and specification are obtainable from Mr. C. M. Holland, Chief Engineer, Hall of Records, New York, at a cost of five dollars for each contract, or can be inspected at the Department of Overseas Trade (Room 49), 35, Old Queen Street, S.W.1.

IRON AND STEEL MARKETS.

Pig-iron.

Notwithstanding the fact that a very large proportion of the blast-furnace plant of the country is still idle, conditions in the pig-iron trade, it is satisfactory to note, are certainly improving, if slowly, but pending some definite pronouncement by ironmasters on the subject of further price reductions, business at the moment is necessarily restricted in volume. In the West of Scotland, with the steelworks taking an unusually prolonged holiday, demand for pig-iron is naturally much below the average at this season, the nine furnaces now in blast, out of some sixty available, being quite sufficient at present to meet consumers' requirements, very little of this quality of iron now going for export. In the Clyde-side area also the subject of a reduction of rail rates for the transport of iron and steel is still in abeyance, which places Scottish smelters at a considerable disadvantage as compared with their southern trade contemporaries. South Staffordshire and Midland iron smelters report extremely quiet conditions, only one firm now producing for the open market, which continues weak, with prices realised said to be unremunerative. A rather better prospect is, however, reported at Tees-side, inquiries both for home and foreign consumers being much more numerous, and it is only the expectation of, and indeed the insistence upon, price concessions which has held up the completion of contracts. Cleveland makers were consequently pressed to embark upon a bold policy of price-cutting, which it was urged would meet with an immediate reward in an expansion of business, and although the trade position was decidedly difficult, the combined effect of the fall in wages and in railway rates should, it was thought, enable a further cut in prices to be made. As anticipated would be the case, this materialised during the current week, and although buyers were holding off there should be no further excuse for doing so. Prices are now at 95s. for No. 1 Cleveland, 90s. for No. 3 G.M.B., 87s. 6d. for No. 4 foundry, and 82s. 6d. for No. 4 forge. For mottled and white 80s. per ton is quoted, but makers are open for offers.

Among the more hopeful signs of trade revival is the growing activity of demand for hematite, some good sales of East Coast mixed numbers having been effected recently, while substantial orders, said to have been placed, give promise of a continuity of work at the furnaces. The price current for mixed numbers is now quoted 97s. 6d., but this figure might be shaded against firm offers, with No. 1 quality marked 2s. 6d. per ton more.

Finished Iron.

Restricted buying in the finished iron branch continues the order of the day, while many of the works in the South Staffordshire area have not yet resumed operations, and order books are lamentably short of fresh specifications. Only slender hopes are now entertained that the forthcoming quarterly meeting of manufacturers will witness any general revival of demand, nor is there any sanguine expectation of startling price changes, which, to be effective, will have to show a further extension of the price-cutting policy pursued by makers during the year just closed. It is, however, difficult to understand how such a movement can be feasible in the existing conditions without a further reduction in costs of production, of which the excessive charges for transport freights of raw material and finished goods is a by no means inconsiderable factor, the recent concession offered by the railway companies having been miserably inadequate to meet the situation. Makers of marked bars are understood to be resuming operations with only a few orders in hand, while firms dealing with the commoner qualities are keenly competing for any fresh business in circulation of very limited tonnage at that, which are said to be offering in the market at not much above £12, although the Association members are adhering strictly to the official basis of £13. The slump in the nut and bolt industry in the Black Country continues unrelieved, while the demand for iron strip is very poor, the use of this material having been practically superseded by steel, which can be bought at a cheaper rate.

Steel.

A very belated start is being made in the steel trade after the Christmas vacation, most of the Sheffield firms having little work in hand, though in South Wales, the Midlands and Teesside conditions are reported slightly better. The most hopeful feature, perhaps, in the position of the industry is a steady increase in the volume of inquiries, which combined with a corresponding reduction of prices should shortly result in a more active demand for steel products, both on home and export account, recent price movements in a downward direction having brought home values of material on a level with those of our chief foreign competitors. At present, however, Sheffield armament firms have hardly recovered from the setback of the cancelled Admiralty orders for battleships, while local works are also affected by the universal stagnation of the shipbuilding industry. There has been a limited amount of buying in the semi-products section of late, with prices fairly steady, but no improvement can yet be perceived in the output of crucible or open hearth steel, business in these departments remaining very quiet. In view of the more promising outlook in the steel trade in South Wales and Monmouthshire, it is hoped that a satisfactory settlement will now be reached with regard to an outstanding question of skilled workmen's wages in these districts. The men have claimed for an adherence to a weekly wage of £4 5s. and the employers have offered £3 5s. It is now understood that the issue will come to arbitration, representatives of both sides meeting at Old Palace Yard, Westminster, this week, in connection with the Ministry of Labour.

Tinplates.

No improvement in conditions can be recorded in the tinplate market, prices showing a distinctly lower tendency, with 20s. per box freely quoted for coke qualities, net cash, f.o.b. Wales. The outlook at the moment is not good; stocks are apparently rather heavy, and many makers are running short of orders. Wasters are quiet, and prices are lower. 39s. has been taken for CW. 28 by 20, and 20s. is now quoted for CW. 14 by 18¾, without finding buyers. Terneplates are easy at 19s. 3d. basis for usual specifications, but buyers are holding off.

Metals.

Copper.—Movements in the copper market of late have shown an improvement, despite the restricted demand for home consumption, and though business on the whole has been limited in volume, the outlook is regarded as fairly encouraging. American cable advices report greatly reduced stocks of the metal, while the exports from transatlantic ports during November were the heaviest for several months past, amounting to over 32,000 tons, of which 12,200 tons went to Germany and over 10,000 were despatched to France, the U.K., and Italy combined, while good quantities went to other European countries and also Japan. The U.K. stocks of rough bar copper were substantially reduced last month. On this side the market for refined copper has been steady with electrolytic quoted at £73 10s., and wire bars £73 10s. Closing prices:—Cash: Wednesday, £65 12s. 6d.; Thursday, £66; Friday, £65 12s. 6d.; Monday, £65 17s. 6d.; Tuesday, £65 7s. 6d. Three months: Wednesday, £66 12s. 6d.; Thursday, £66 17s. 6d.; Friday, £66 10s.; Monday, £66 15s.; Tuesday, £66 5s.

Tin.—Cable advices from the East over the week-end reporting buyers of Straits tin at £171, c.i.f., without eliciting a response from sellers, imparted an easier tendency in the home market, in which the business transacted was on a small scale, and almost entirely confined to forward dealings. At Monday's opening market three months was done at £169 15s., but under pressure of liquidation values relapsed, closing steady with a decline of 20s. for each position. English ingots were firm at £167. Batavian shipments for December amounted to 1,455 tons of Banca and five tons of Billiton. The weekly return of tin stocks in London warehouses shows a decrease of 71 tons, totalling at 4,959 tons; Liverpool stocks being 23 tons lighter at 2,141 tons, with Swansea unchanged at 10 tons. Closing prices: Cash: Wednesday, £167 12s. 6d.; Thursday, £167 12s. 6d.; Friday, £167 15s.; Monday, £166 15s.; Tuesday, £165 5s. Three months: Wednesday, £169 12s. 6d.; Thursday, £169 12s. 6d.; Friday, £169 15s.; Monday, £168 15s.: Tuesday, £167.

Spelter.—Conditions in the spelter market have recently developed an uncertain tendency, although there has been improved buying on account of the galvanising trade. Some forward lots have been disposed of, but business all round is rather quiet. Closing prices:—Wednesday, £27 12s. 6d.; Thursday, £27 5s.; Friday, £27 7s. 6d.; Monday, £27; Tuesday, £27 2s. 6d.

Lead.—Some signs of improvement have been noted in the market for soft foreign pig, with prices showing a stiffening tendency at intervals, but only a moderate turnover is reported. English closing prices:—Wednesday, £26; Thursday, £26; Friday, £26; Monday, £26. Tuesday, £26.

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Book Reviews.

WILLING'S PRESS GUIDE AND ADVERTISERS' DIRECTORY AND HANDBOOK. — London: James Willing, Limited, 30, King Street, Covent Garden, W.C.2. (Price 2s. 6d.)

This is the 49th annual issue of this well-known handbook, which, we are told, has been carefully revised.

MATERIALPRUEFUNGSWESEN. By Prof. K. Memmler. Part II.—Berlin: Walter de Gruyter & Company, Genthinerstrasse 38, W.10. (Price 1s. 6d.)

We reviewed Part I. of this book in our issue of October 6. The present part deals briefly with the testing of metals (cast iron, wrought iron, steel, copper, bronze, etc.) and other materials used in machinery construction (belts, ropes, chains, indiarubber, etc.). The Association of German Iron Foundries has drawn up specifications for the various kinds of cast iron (for machinery, building, construction, columns and pipes), but these are to be radically revised and enlarged by the Standards Committee of German Industry. Further sections deal with (1) metallography, (2) the testing of building materials in their raw and finished state (walls, ceilings, stairs, fire tests, etc.), (3) the testing of paper, (4) of textile fabrics, (5) lubricants, and (6) colours, paints and varnishes. Both parts have now reached a third edition.

HANDBOOK FOR IRONFOUNDERS. The Frodair Iron and Steel Company, Limited, London. Published by the Locomotive Publishing Company, Limited, 3, Amen Corner, London, E.C.4. The aim of this book, as expressed in the introduction, is not to upset accepted theories and practices, but rather to draw freely upon all available information and experience with a view to assisting the foundryman in the issues which are all-important to him. Broadly speaking, this object has been achieved. The manner of its accomplishment has been to outline the manufacture of pig-iron, the constitution of cast iron, the mixing of cast iron and the influence of the constituents on its properties, action and interaction of different elements, iron mixtures for special castings, behaviour of cast iron when subjected to high temperature conditions, cylinder castings, chilled castings and castings made in permanent moulds, adding steel to cast iron in the cupola, mechanical testing of cast iron, cupola practice, fans and blowers, areas of various pouring gates, calculation of the weights of castings, moulding sands. This matter, which is largely a compilation of the views of the various experts, is followed by some 16 pages of useful tables. It is a book which will be appreciated by all connected with the ironfoundry industry. Published at 3s. 6d. net.

The British Trade Ship.

The Board of the British Trade Ship, of which Earl Grey is the chairman, publish information which may be regarded as a barometer showing the present and prospective fall in costs of production. It is another sign of the tendency to get the prices of British manufactures down to the level where exports may begin again to flow.

The original figures on which the estimates for the building of the Trade Ship were based are now almost a year old. Since then manufacturing and other costs have shown a tendency towards decline. Although many items of cost have only fallen slightly during this period, yet there has been a very distinct fall in prices in the many parts of a ship's construction and equipment.

Anticipating a further fall not only in cost of construction but also of voyaging, the Board of the British Trade Ship has at once decided to give the exhibitors the present and prospective advantage by reducing the cost of space by 33⅓ per cent. This reduction also applies to the cost of sending a representative of the firm on tour in the ship itself. The reduction will be retrospective.

The terms for exhibiting are forthwith reduced from between £2,100 and £1,350 for stalls to £1,400 and £900 respectively. The cost of showcases and countercases is similarly reduced to an average charge of about £400. First-class cabin accommodation for a trade representative undertaking the whole voyage of 18 months is reduced to the sum of £1,000, including all meals taken on board the ship.

Company News.

Leopold Ward, Limited.—Capital £3,000 in £1 shares (2,000 pref. and 1,000 ord.). Engineers, machinists, etc.

Harvey & Spencer, Limited.—Capital £36,000 in £1 shares. Engineers. Registered office: 25, Victoria Street, Westminster, S.W.

Frodair Iron & Steel Company, Limited. — Profit, £10,062; brought forward, £10,494; available, £20,546; dividend, 10 per cent.; carry forward, £12,134.

Jesshope, Limited.—Capital £2,000 in £1 shares, to carry on the business of mechanical, electrical, and general engineers, etc. Registered office: Dale Street, Burslem.

Henry Levin Webb & Company, Limited.—Capital £5,000 in £1 shares. Metal merchants. Directors: H. Levin and O. H. Levin. Registered office: 9, Sugar House Lane, Stratford, E.15.

Tees to Tyneside, Limited.—Capital £500 in £1 shares. Engineers. Directors: W. Elcoat and H. Gill. Secretary: W. Elcoat. Registered office: 26, Grange Road, Norton-on-Tees.

Concentric Manufacturing Company, Limited. — Capital £1,500. Brass and iron founders, etc. Directors: H. Bowker, S. H. Sershall, T. Avery, F. Saunders, S. G. Morgan and H. R. C. Lyster. Registered office: Aston Lane (Priory Road Corner), Aston, Birmingham.

Gazette.

TRADING IN THE STYLE of A. J. Jones & Company, Messrs. C. Harrison and A. J. Jones, 99, Curtain Road, E.C., and 42 and 44, Haymerle Road, S.E., general and chemical engineers and millwrights, have dissolved partnership. Debts by Mr. A. J. Jones, by whom the business will be carried on at 42 and 44, Haymerle Road.

THE CREDITORS of William Parry, Limited, engineers, Whittington Moor, Dronfield, met at the Official Receiver's Offices, Sheffield, on December 30, when the affairs of the company were left in the hands of the Official Receiver. The business acquired by the company was formerly carried on by Mr. W. Parry, 46, St. John's Road, Whittington Moor, as the Dronfield Engineering Company, and subsequently as William Parry & Company, Limited, at Foundry Street, Whittington Moor. Since June the registered offices of the company have been in Sheffield. The gross liabilities are £387, and on the contributories' account there is a deficiency of £815. According to Mr. William Parry, managing director of the concern, the present position is due to the slump in trade.

Personal.

THE LATE Mr. J. W. Leigh, London manager for John Lysaghts, Limited, left estate of the gross value of £1,417.

MR. F. P. HANN has been appointed general manager of the Ebbw Vale Steel, Iron & Coal Company, Limited, and its sister companies.

WE ARE informed that the condition of Sir Geo. Carter, managing director of Cammell, Laird & Company, Limited, remains unchanged.

Grants for Scientific Research in Norway. — The British Minister at Christiania reports that grants have now been made for the following purposes among others:—(1) 8,000 kronor (£440 at par) for experiments to be made in connection with the use of acetylene gas as motor fuel; (2) 6,000 kronor (£330) to examine the possibility for employing calcium carbide as a basis for further manufacture in Norway.

Invitation to British Students from French Works. —Some engineering firms in Lorraine (rolling stock, railway material, etc.) having consented to accept, for periods of two or three months, a few British engineering students during the summer, applications in writing, stating age, qualifications, and giving references, will be received (until further notice) by the Hon. Secretary, British Section of the Société des Ingénieurs Civils de France (45, Great Marlborough Street, London, W.1). Students will not receive any wages, and will make their own arrangements for the journey, board and lodgings. Local members of the Société will give advice in these matters, if desired. Students will undertake to submit to the same discipline and working hours as their French colleagues on the works' staff. Some knowledge of French is advisable.